

1. INTRODUCTION

In view of the importance of Earth's radiation budget measurements in trying to understand climate on various temporal and spatial scales, NASA, in close collaboration with NOAA and university scientists, planned and proposed an Earth Radiation Budget Satellite System (ERBSS) as a "new start" in fiscal year 1979. This system, described in Appendix A, consists of three satellites and is designed to obtain radiation budget data from the early 1980s through the mid-1980s and will thus provide better coverage than any previous system, and, at the same time, extend the time span of radiation budget measurements. Several university and government scientists participated in the ERBSS new start planning. However, in order to involve the widest possible segment of the scientific community in the planning for the ERBSS data use, NASA sponsored a Workshop on Earth Radiation Budget Science at Williamsburg, Virginia, March 28-30, 1978. The purpose of the Workshop was to draw upon the combined expertise of scientists concerned with the use and production of satellite measurements of various components of the Earth's Radiation Budget (ERB), in order to assess the present state of the knowledge in this field, acquire better understanding of and definition of the needs and requirements of the ERB data user community, and identify and recommend future research activity in this area.

There were two specific objectives for these discussions. The first objective was to address the ERBSS data uses, so that the needs and requirements of the data users could be incorporated in ERBSS planning and the scientists could begin their planning for use of the data. The second objective was to acquire information regarding the scientists' needs and requirements for use in formulating NASA's long range plans for a Radiation Budget Program.

The format of the Workshop included a brief plenary session on each of the three days--the remainder of the time being devoted to deliberations by six working groups into which the Workshop participants were divided. The first half-day of the Workshop was devoted to presentation and plenary discussion of papers which provided general background information regarding the accomplishments to date in the field of Earth Radiation Budget. In his opening remarks, Dr. L. R. Greenwood, Jr., NASA Headquarters, discussed the opportunities to participate in Science Planning and Analysis of the ERBSS project. Dr. T. Vonder Haar, Colorado State University (CSU), discussed the plan for the format of the Workshop. Dr. R. Curran, Goddard Space Flight Center, gave an overview of Science Requirements for ERBSS Measurements. Other

presentations included discussion of recent results from the ERB instrument on the NIMBUS-6 spacecraft and plans for the ERB instrument on the NIMBUS-G (NIMBUS-7) spacecraft by Dr. H. Jacobowitz, NOAA/National Environmental Satellite Service (NESS); and a description of the proposed ERBSS system by C. V. Woerner, NASA-Langley Research Center. On the second day, Dr. P. K. Rao, NOAA/NESS, presented an overview of the TIROS-N Program and the correlative data; and Dr. E. Bierly, National Science Foundation, gave an overview of the U.S. Climate Program and Related International Activities. The remaining time was devoted to working group discussions of six specific topics and to plenary discussions of the outcome of the working group deliberations.

The central themes of the working group discussions were arrived at on the basis of the following considerations. It was realized that the two major users of the Earth radiation budget data are the scientists who work either with climate models or in climate diagnostic studies to unravel the processes of weather and climate. Working groups on climate modeling and climate diagnostics were, therefore, set up to address these two categories of ERB data uses. A third working group was formed to focus on the applications of radiation modeling to ERBSS. Modeling of the radiation field is needed in ERB experiments as well as ground truth measurements. An example is the determination of the flux of radiation energy at the top of the atmosphere from measurements of radiant intensity obtained by scanning and wide angle radiometers mounted aboard a spacecraft. In conducting climate studies based on radiation data, correlation studies are an important tool for establishing and quantifying relationships between radiation budgets and other climate variables. The variability of the radiation field also is of importance in the design of the observation system. Accordingly, one working group considered radiation variability and correlation studies. Since on the average about one-half of the Earth is covered with high albedo clouds, they have a strong influence on the radiation budget and atmospheric circulation; therefore, another working group dealt with cloudiness and the radiation budget. Since the planning and implementation of a satellite project requires a long lead time, it was felt that although ERBSS had only recently been approved, it was an appropriate time to begin deliberations on the future requirements for radiation budget measurements. Thus, a working group was formed to consider ERB measurements for the late 1980s. The chairmen and topics for the six working groups were: Dr. C. E. Leith, National Center for Atmospheric Research (NCAR)--Climate Modeling; Dr. J. Winston, NOAA/NESS--Climate Diagnostics; Dr. K. Coulson, University of California at Davis--Radiation Modeling; Dr. H. Jacobowitz--Radiation Variability and Correlation Studies; Dr. S. Cox, CSU--Cloudiness and the Radiation Budget; Drs. V. Suomi, University of

Wisconsin, and T. Vonder Haar, CSU--Radiation Budget and Related Measurements in 1985 and Beyond.

The deliberations and recommendations of the working groups were summarized into reports by the working group chairmen. Each of these reports is included in a separate section (Sections 2 to 7) in this volume. In this task, the chairmen were ably assisted by the working group participants and the working group technical assistants, who acted as rapporteurs. The technical assistants for the six working groups are listed in the preface to this volume. Three papers, separately authored by C. V. Woerner, Dr. C. E. Leith, and Dr. V. Ramanathan, in support of some of the deliberations of the Workshop, are given in Appendices A, B, and C, respectively, and a list of participants is given in Appendix D. The first paper was presented at the Workshop plenary session and the last two were discussed during the deliberations of the working group on Climate Modeling. Other aforementioned papers at the plenary sessions were not included as they were not available for inclusion in the Workshop proceedings.